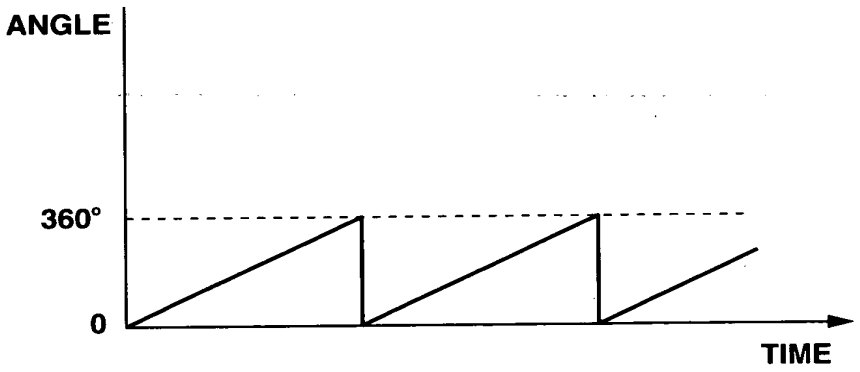


FIG.1

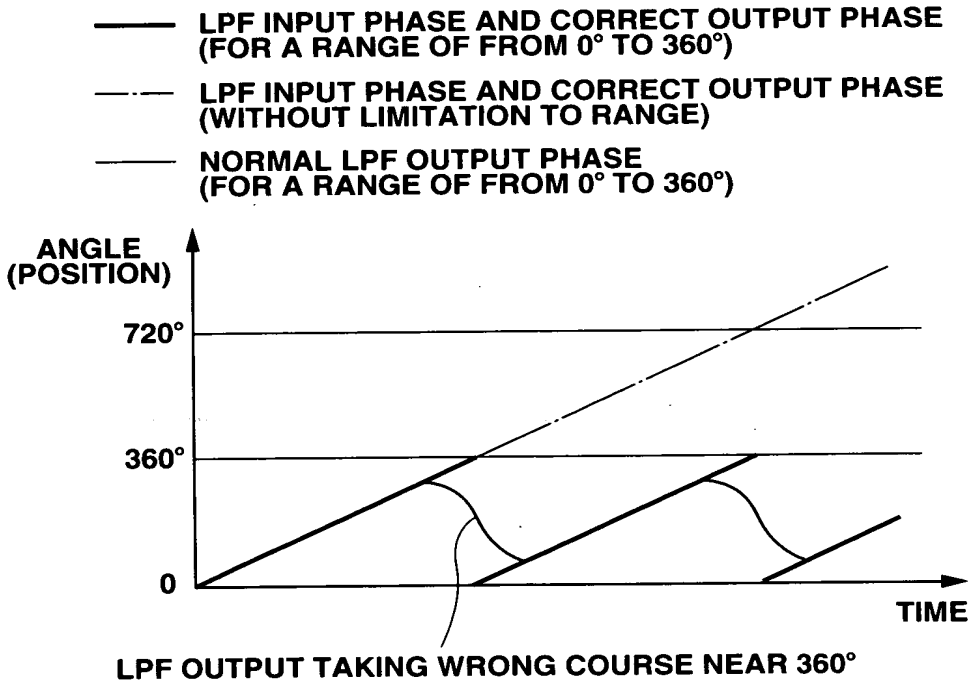


FIG.2

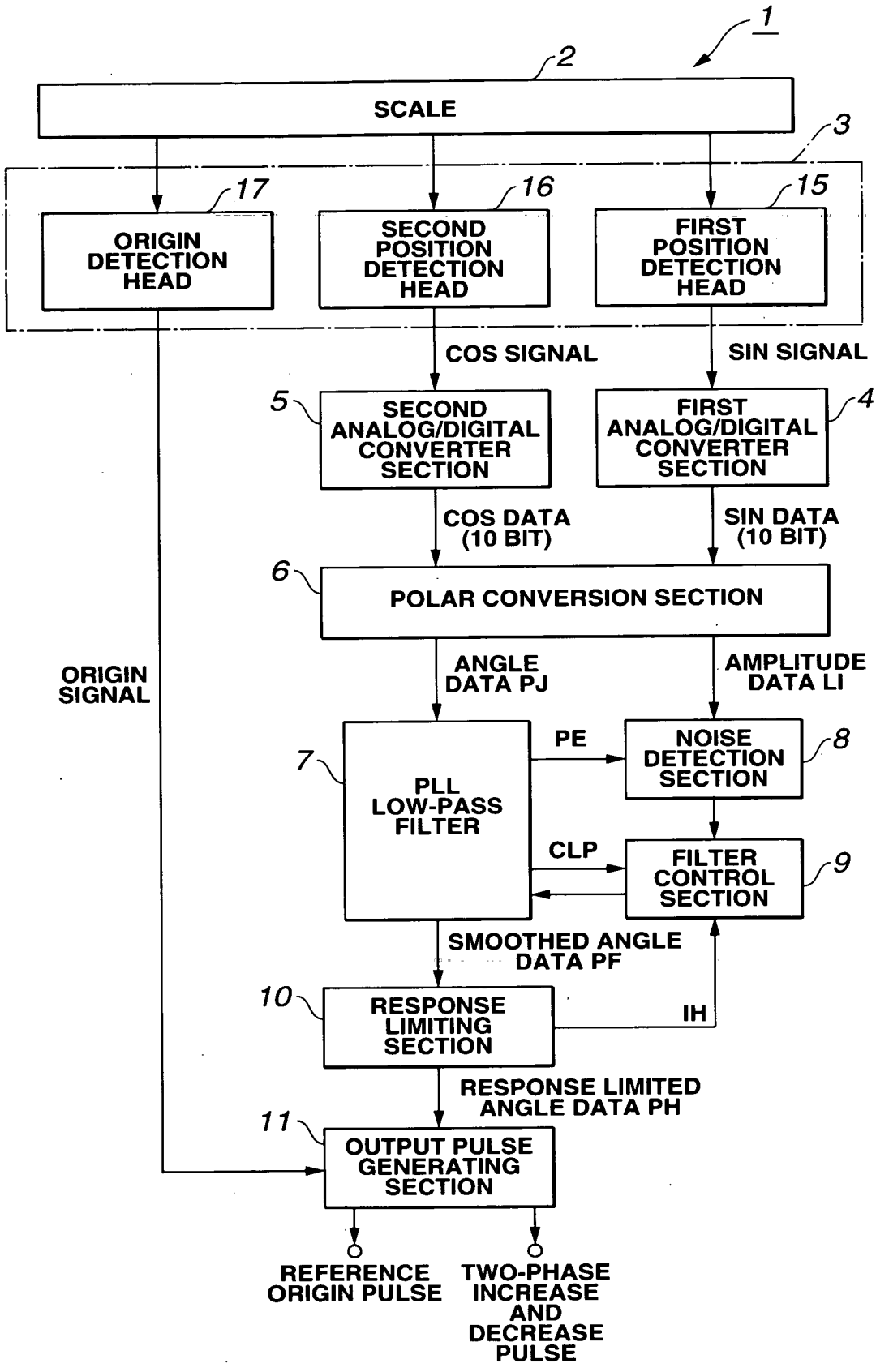

1
2
SCALE
3
17
16
15
ORIGIN DETECTION HEAD
SECOND POSITION DETECTION HEAD
FIRST POSITION DETECTION HEAD
COS SIGNAL
SIN SIGNAL
5
SECOND ANALOG/DIGITAL CONVERTER SECTION
FIRST ANALOG/DIGITAL CONVERTER SECTION
4
COS DATA (10 BIT)
SIN DATA (10 BIT)
6
POLAR CONVERSION SECTION
ORIGIN SIGNAL
ANGLE DATA PJ
AMPLITUDE DATA LI
7
PLL LOW-PASS FILTER
PE
NOISE DETECTION SECTION
8
CLP
FILTER CONTROL SECTION
9
SMOOTHED ANGLE DATA PF
10
RESPONSE LIMITING SECTION
IH
RESPONSE LIMITED ANGLE DATA PH
11
OUTPUT PULSE GENERATING SECTION
REFERENCE ORIGIN PULSE
TWO-PHASE INCREASE AND DECREASE PULSE

FIG.3

FIG.4A

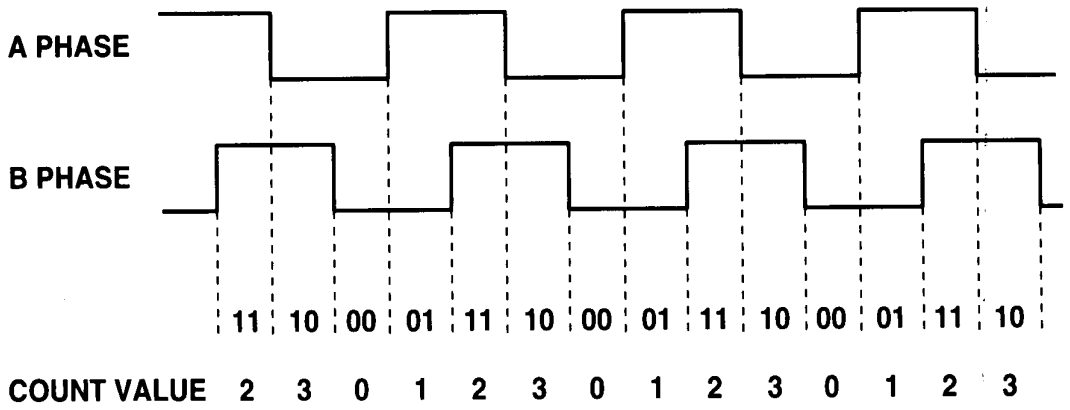


FIG.4B

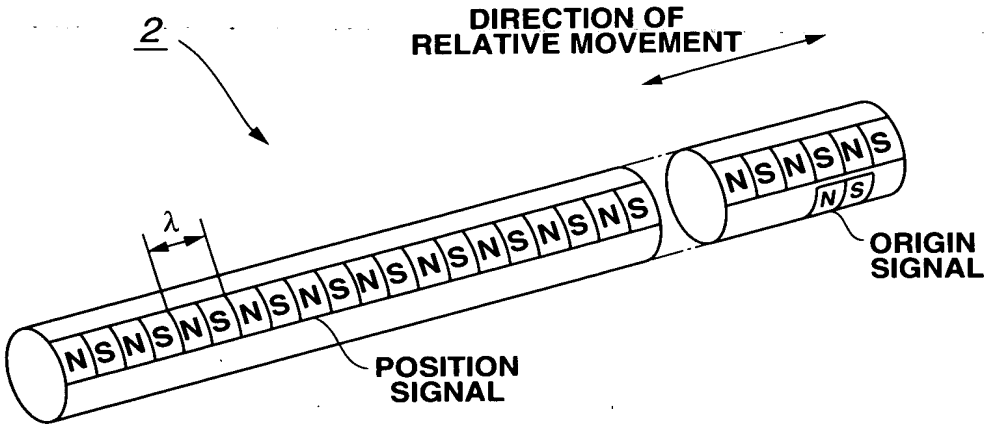


FIG.5

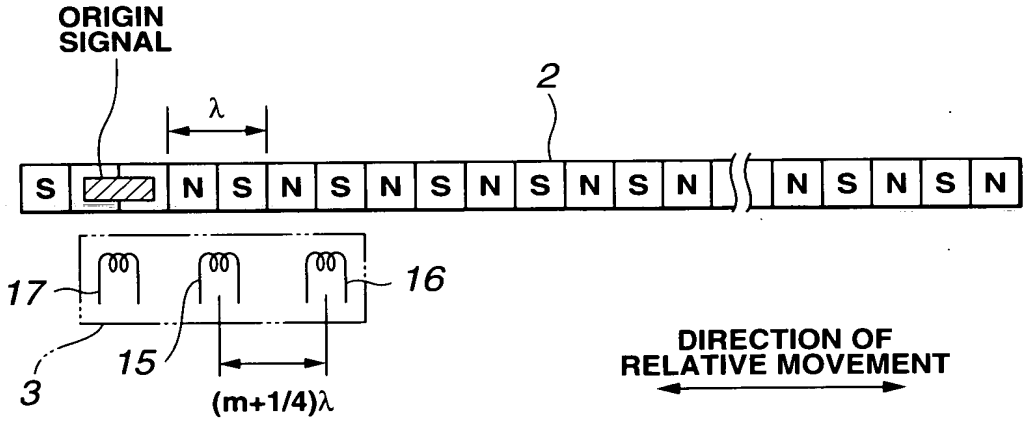


FIG.6

FIG.7A

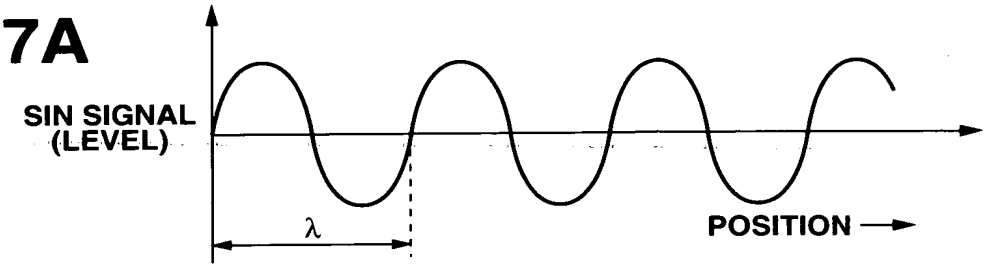
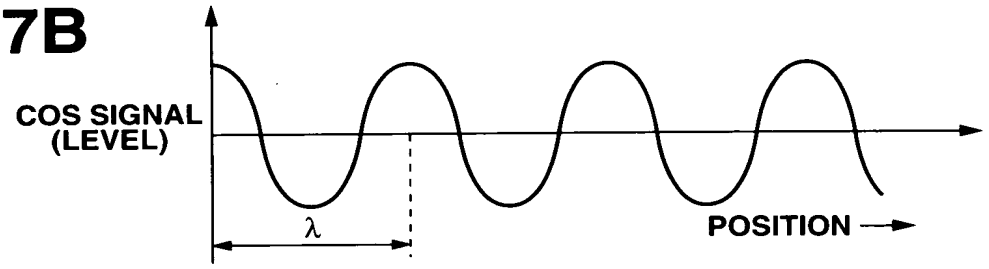


FIG.7B



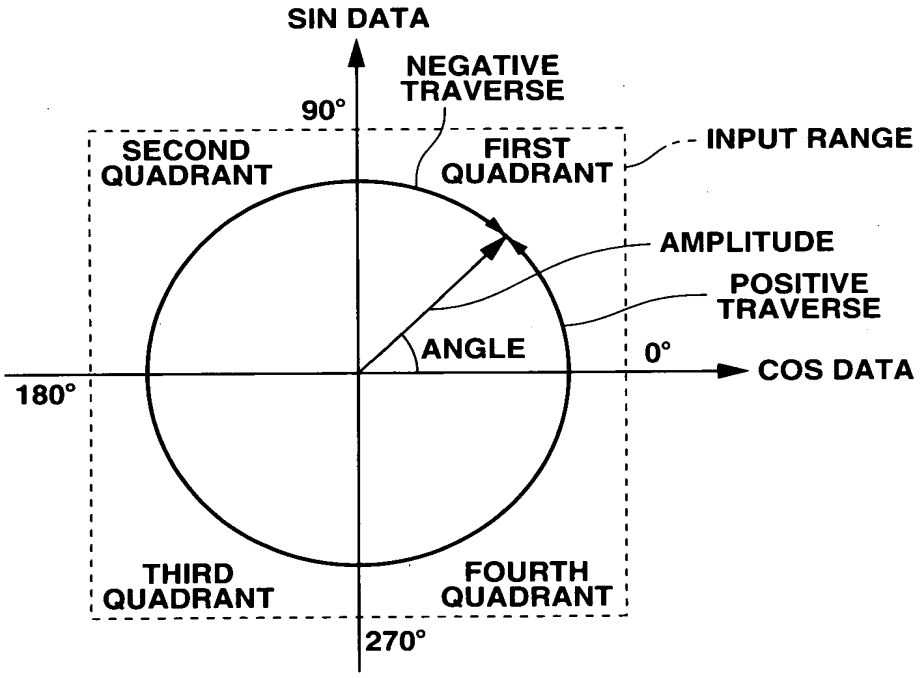


FIG.8

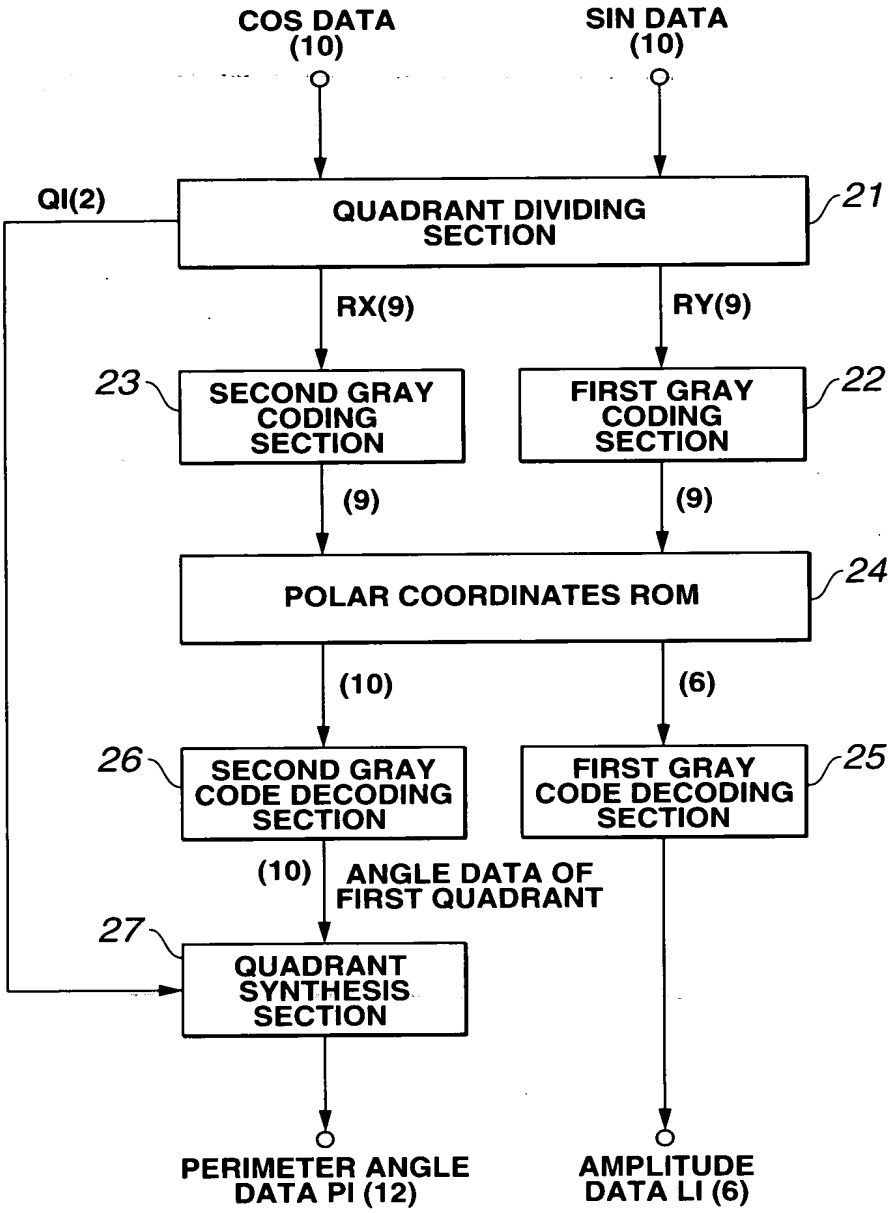

COS DATA (10)
SIN DATA (10)
QI(2)
QUADRANT DIVIDING SECTION
21
RX(9)
RY(9)
23
SECOND GRAY CODING SECTION
FIRST GRAY CODING SECTION
22
(9)
(9)
POLAR COORDINATES ROM
24
(10)
(6)
26
SECOND GRAY CODE DECODING SECTION
FIRST GRAY CODE DECODING SECTION
25
(10)
ANGLE DATA OF FIRST QUADRANT
27
QUADRANT SYNTHESIS SECTION
PERIMETER ANGLE DATA PI (12)
AMPLITUDE DATA LI (6)

FIG.9

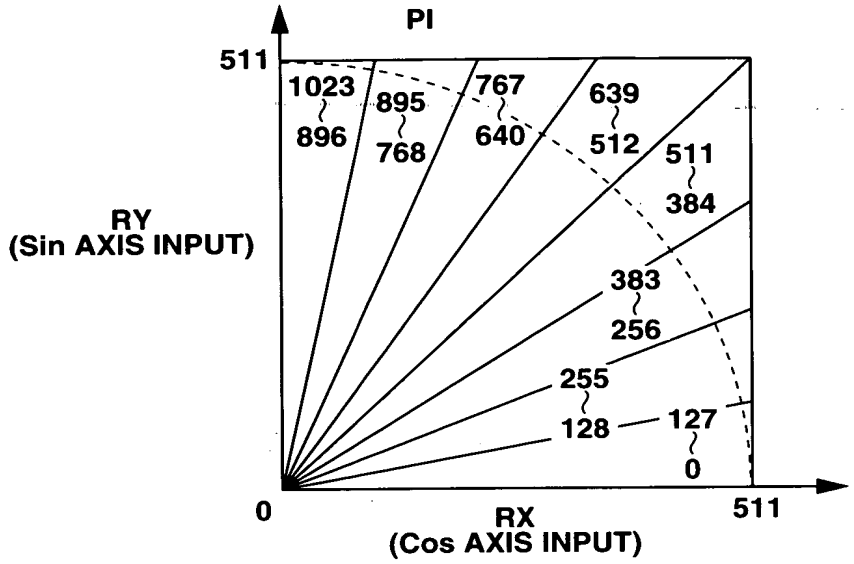

PI
511
1023
896
895
768
767
640
639
512
511
384
383
256
255
128
127
0
RY
(Sin AXIS INPUT)
0
RX
(Cos AXIS INPUT)
511

FIG.10

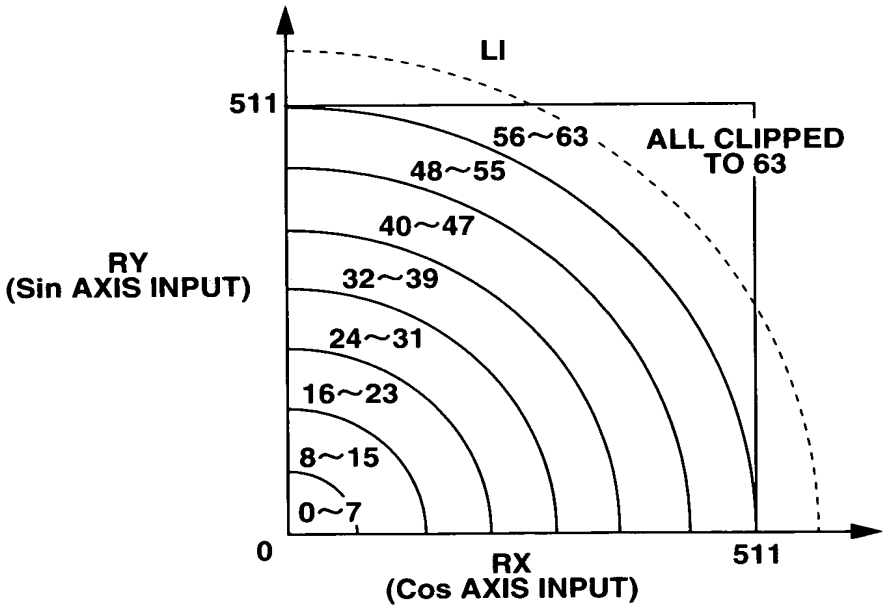

LI
511
56~63
ALL CLIPPED
TO 63
48~55
40~47
32~39
24~31
16~23
8~15
0~7
RY
(Sin AXIS INPUT)
0
RX
(Cos AXIS INPUT)
511

FIG.11

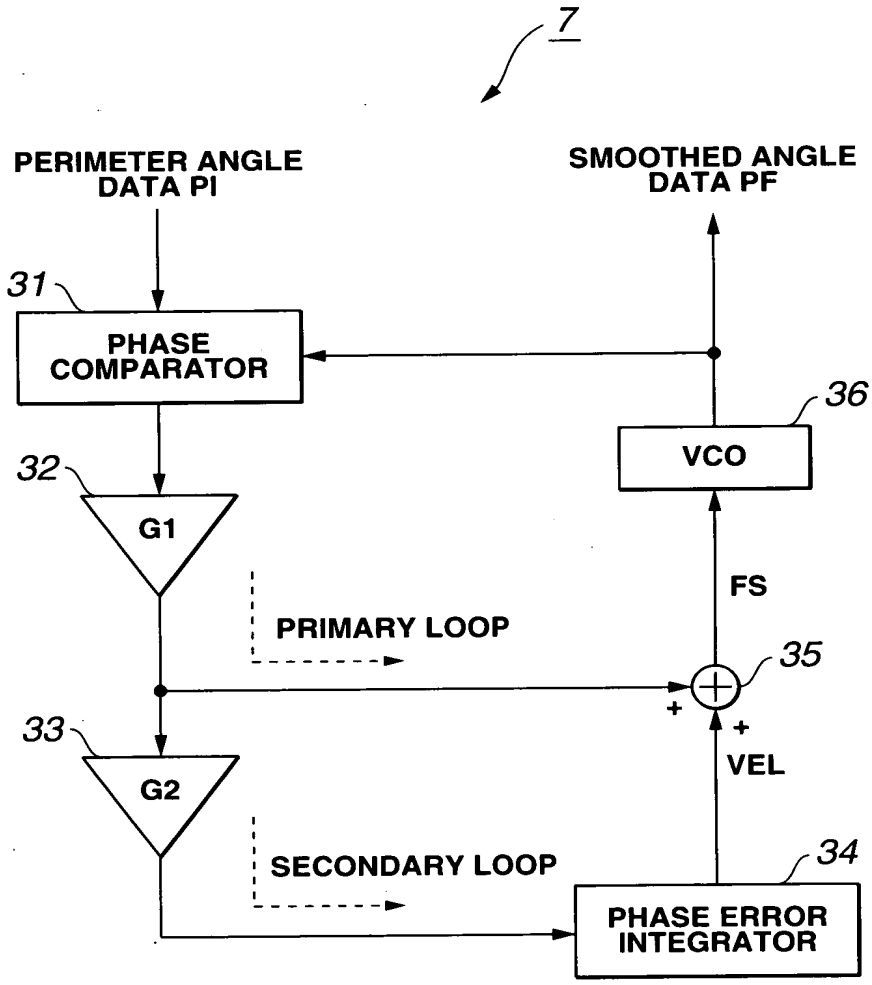


FIG.12

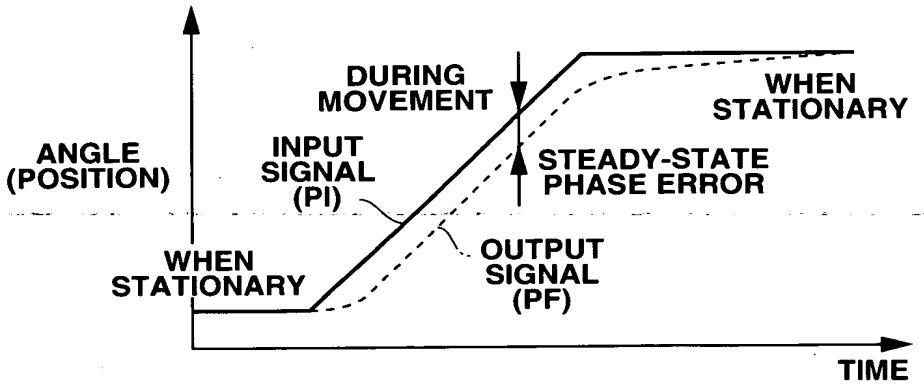


FIG.13

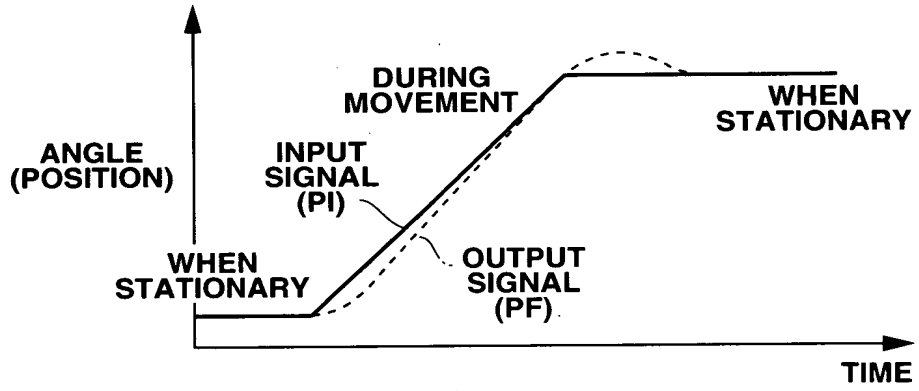


FIG.14

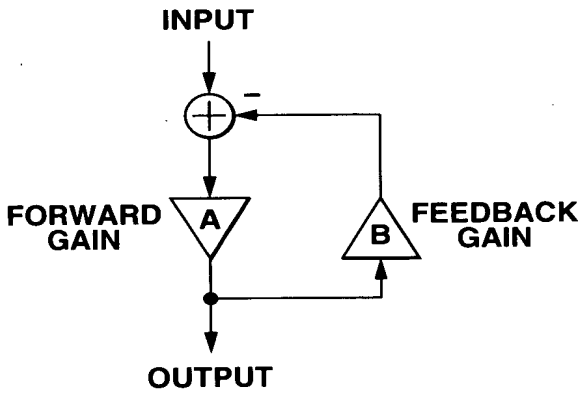


FIG.15

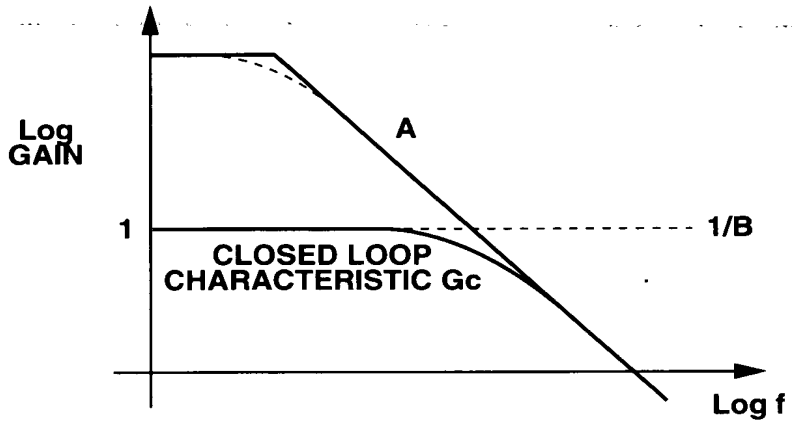


FIG.16

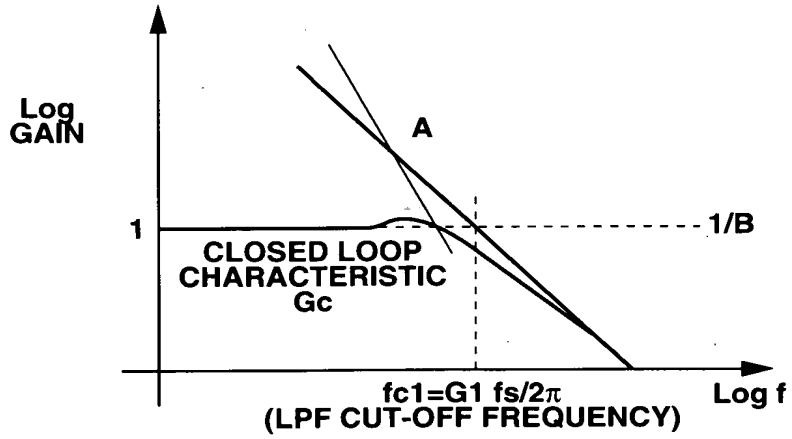


FIG.17

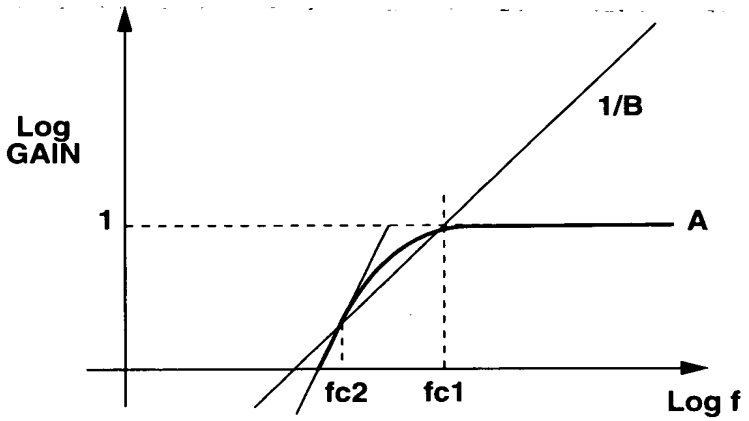


FIG.18

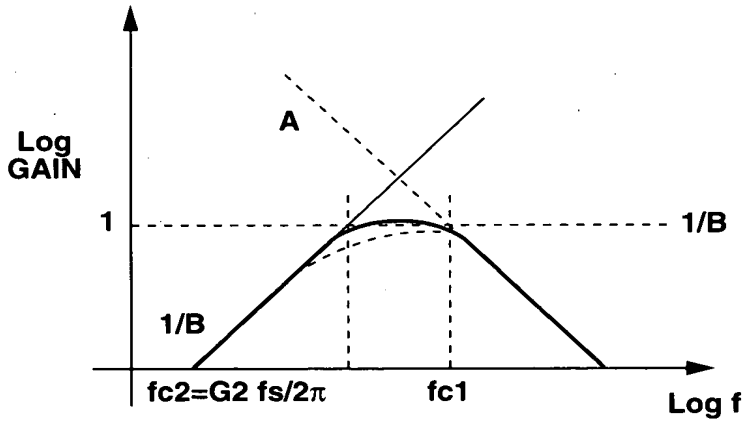


FIG.19

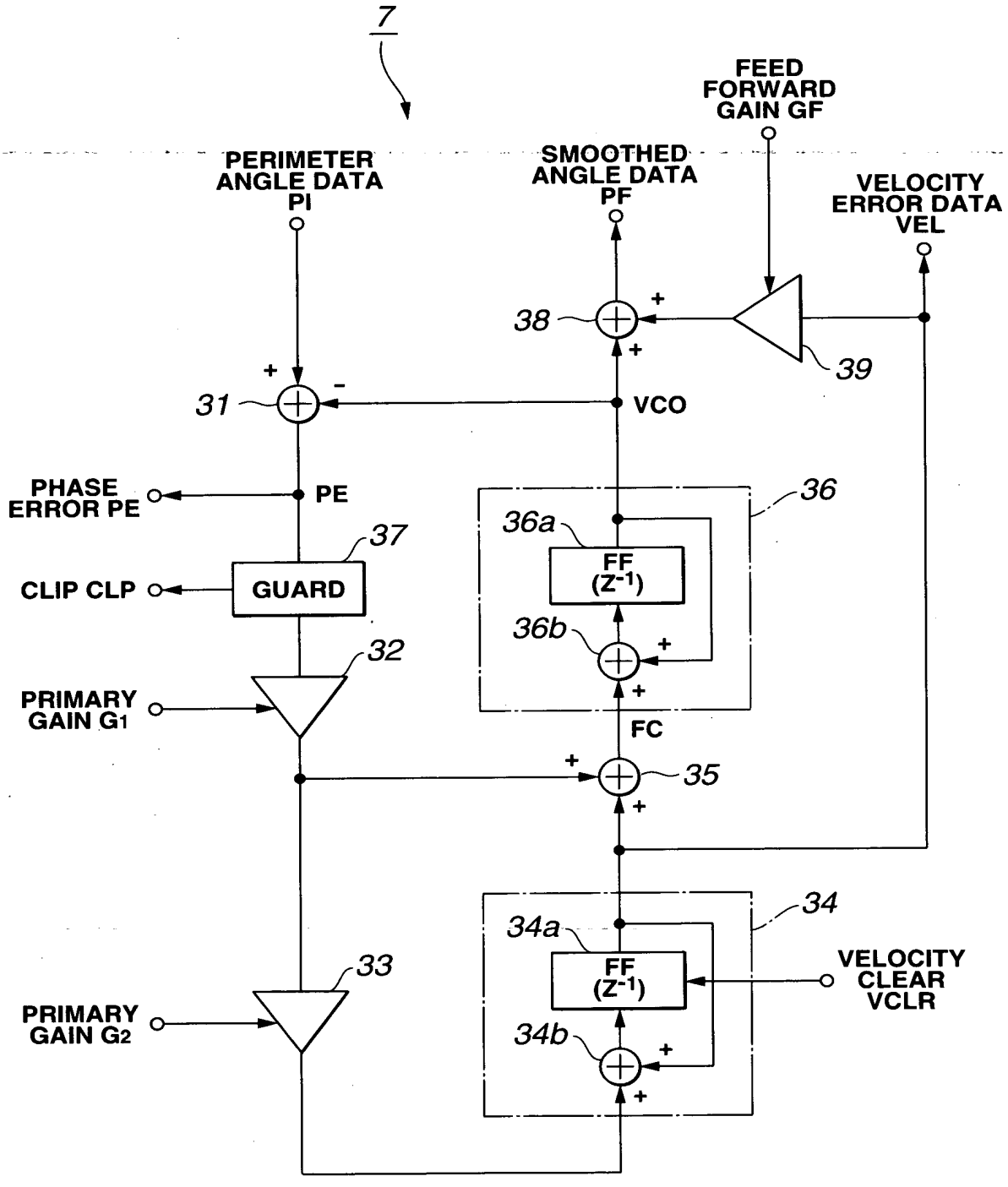

7
FEED FORWARD GAIN GF
PERIMETER ANGLE DATA PI
SMOOTHED ANGLE DATA PF
VELOCITY ERROR DATA VEL
38
39
31
VCO
PHASE ERROR PE
PE
36
36a
FF (Z-1)
37
CLIP CLP
GUARD
36b
32
PRIMARY GAIN G1
FC
35
34
34a
FF (Z-1)
VELOCITY CLEAR VCLR
33
PRIMARY GAIN G2
34b

FIG.20

FIG.21A

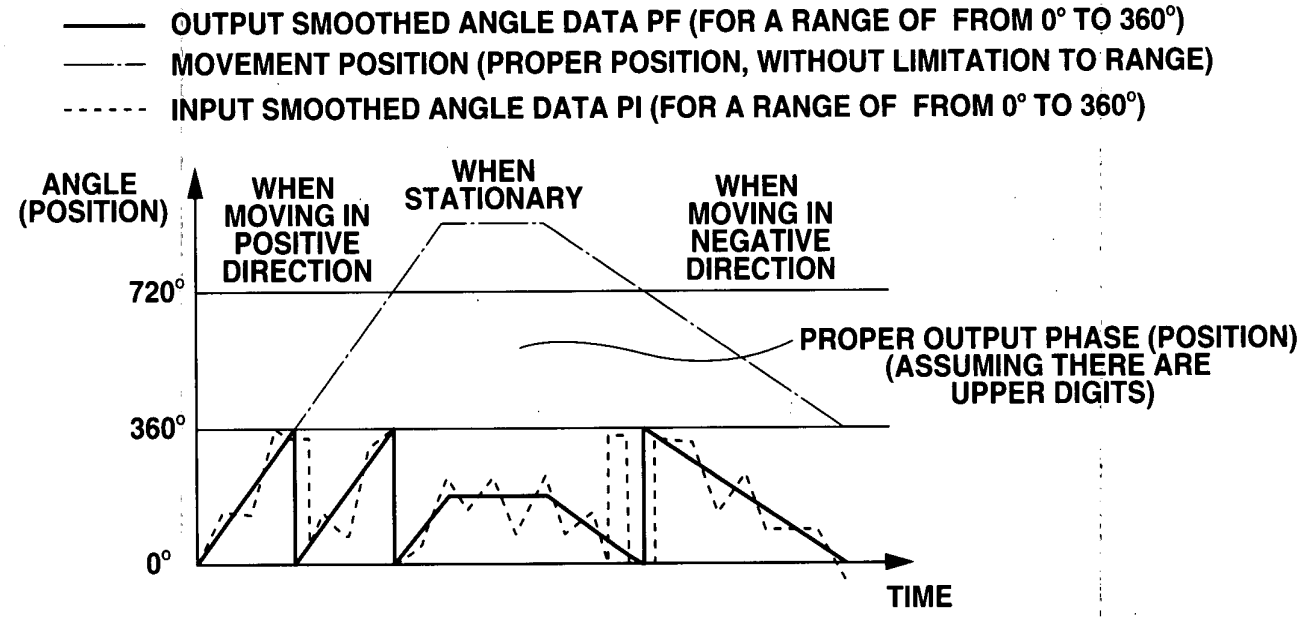
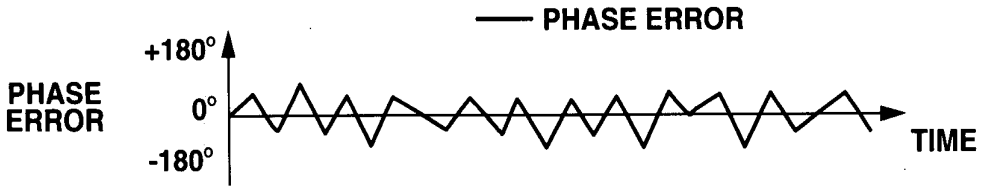


FIG.21B



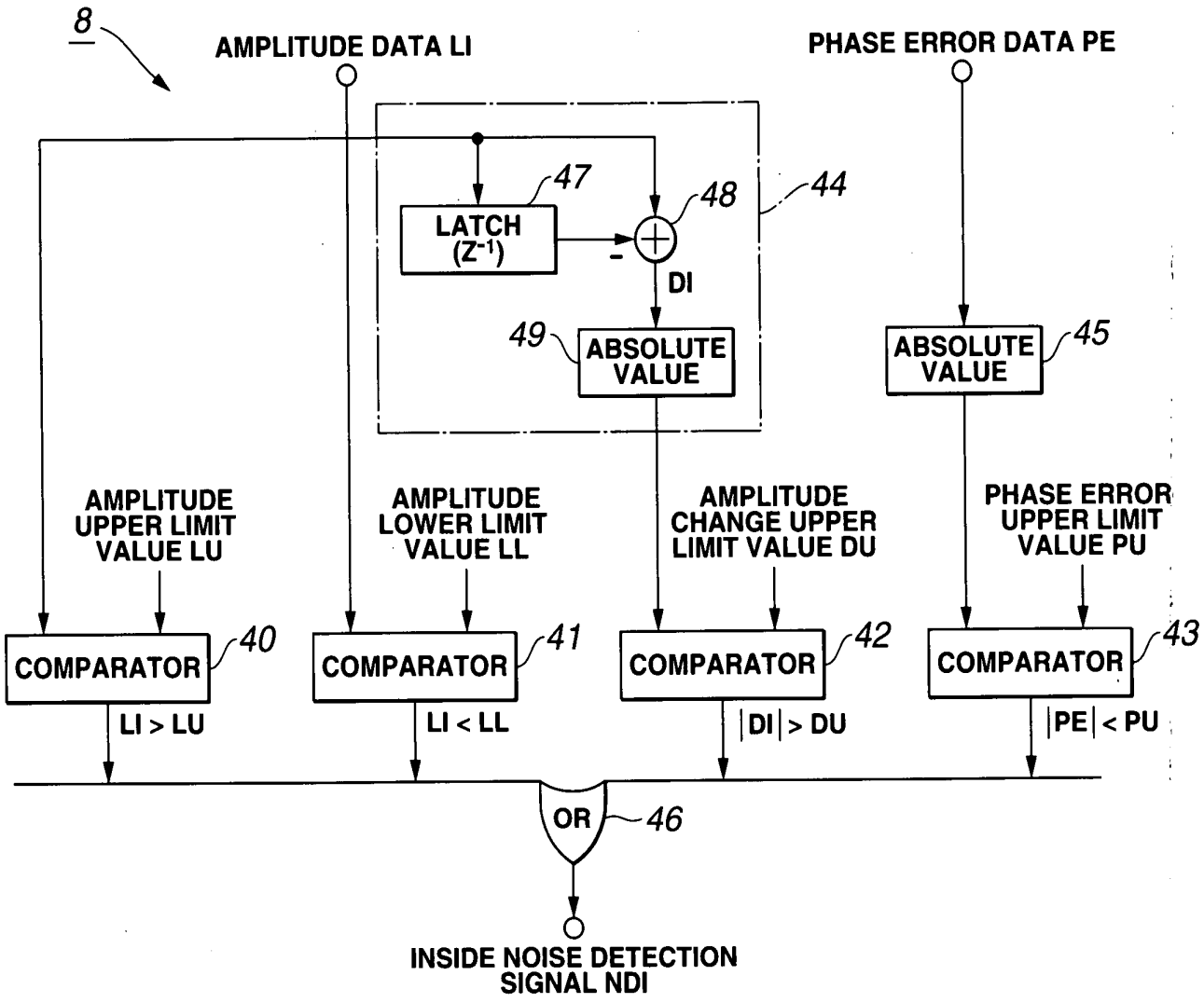


FIG.22

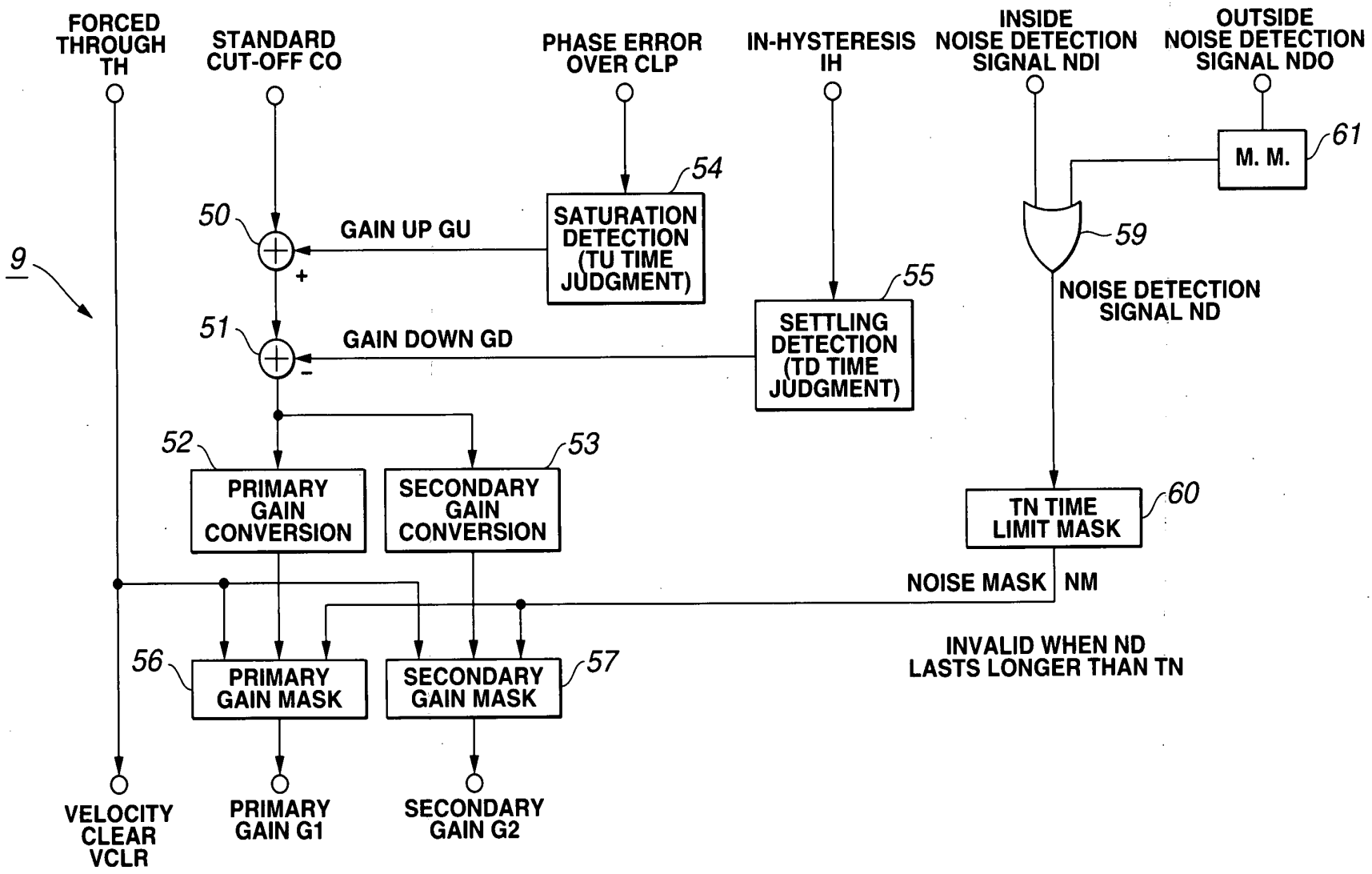


FIG.23

FIG.24A FORCED THROUGH TH (VELOCITY CLEAR VCLR)

FIG.24B NOISE DETECTION ND

FIG.24C IN-HYSTERESIS IH

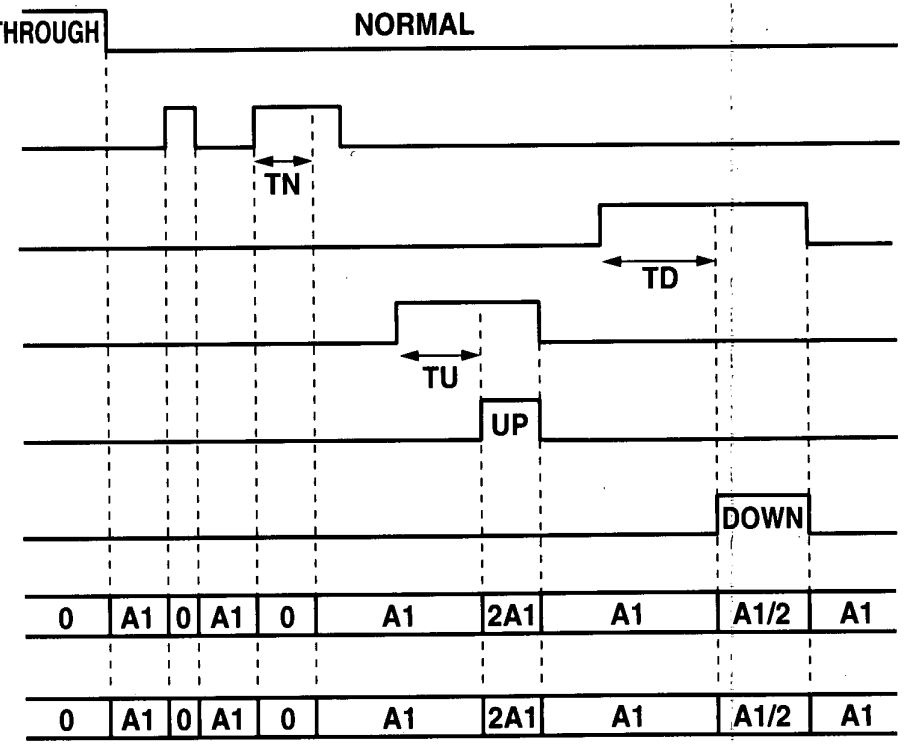
FIG.24D PHASE ERROR OVER CLP

FIG.24E GAIN UP GU

FIG.24F GAIN DOWN GD

FIG.24G PRIMARY GAIN G1

FIG.24H SECONDARY GAIN G2



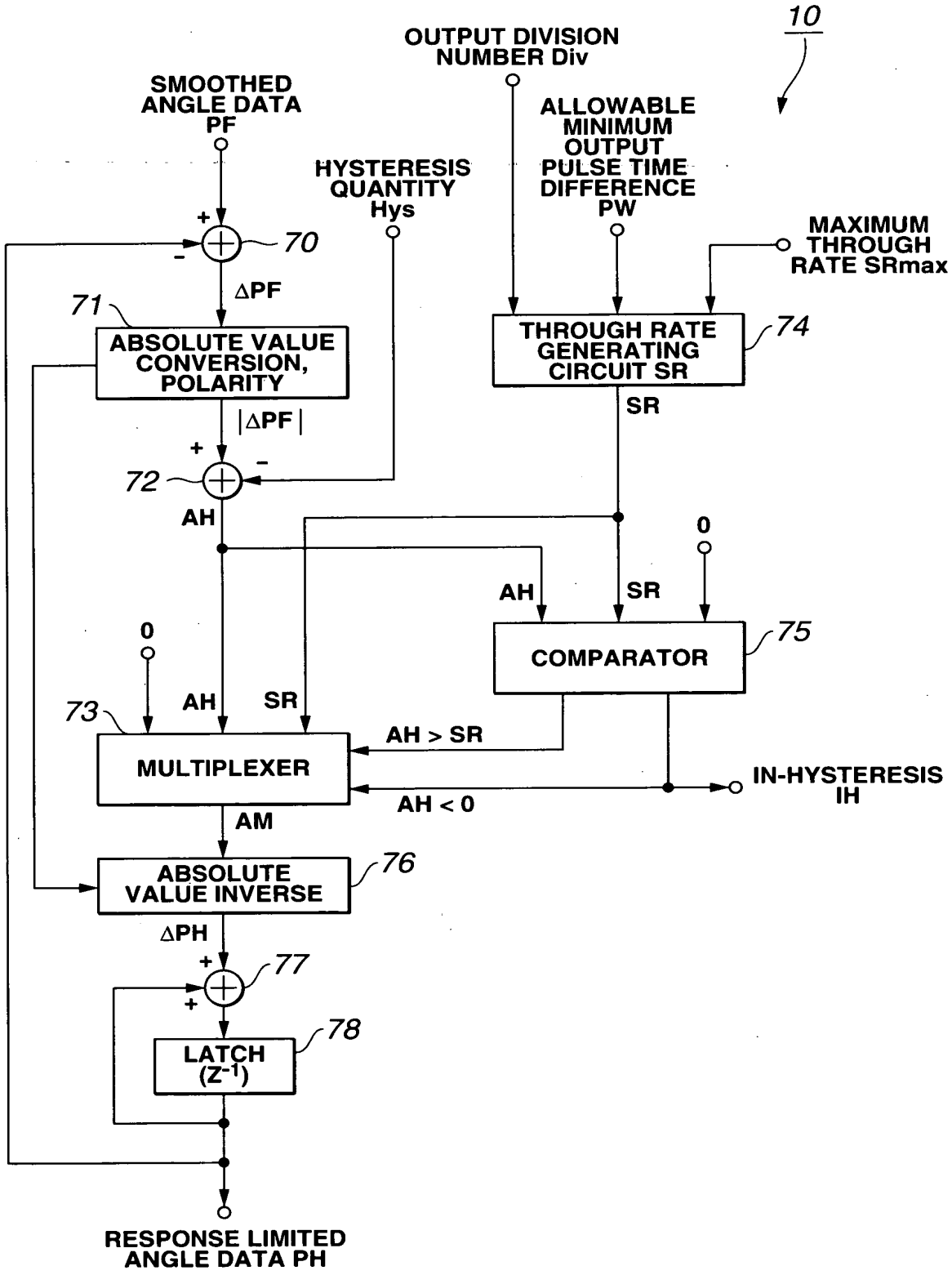

10
OUTPUT DIVISION NUMBER Div
SMOOTHED ANGLE DATA PF
HYSTERESIS QUANTITY Hys
ALLOWABLE MINIMUM OUTPUT PULSE TIME DIFFERENCE PW
MAXIMUM THROUGH RATE SRmax
70
ΔPF
71
ABSOLUTE VALUE CONVERSION, POLARITY
|ΔPF|
72
AH
THROUGH RATE GENERATING CIRCUIT SR
74
SR
0
AH
SR
COMPARATOR
75
0
AH
SR
73
MULTIPLEXER
AH > SR
AH < 0
IN-HYSTERESIS IH
AM
ABSOLUTE VALUE INVERSE
76
ΔPH
77
78
LATCH (Z-1)
RESPONSE LIMITED ANGLE DATA PH

FIG.25

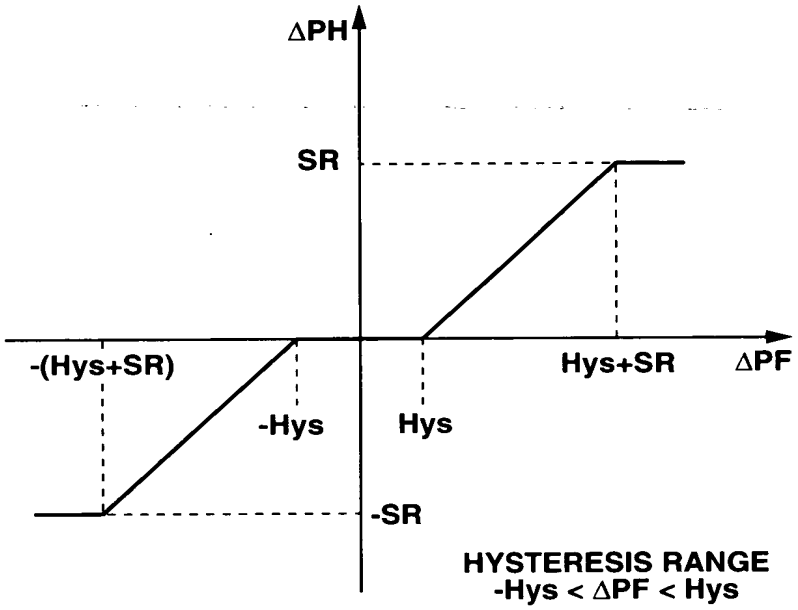

ΔPH
SR
-(Hys+SR)
-Hys
Hys
Hys+SR
ΔPF
-SR
HYSTERESIS RANGE
-Hys < ΔPF < Hys

FIG.26

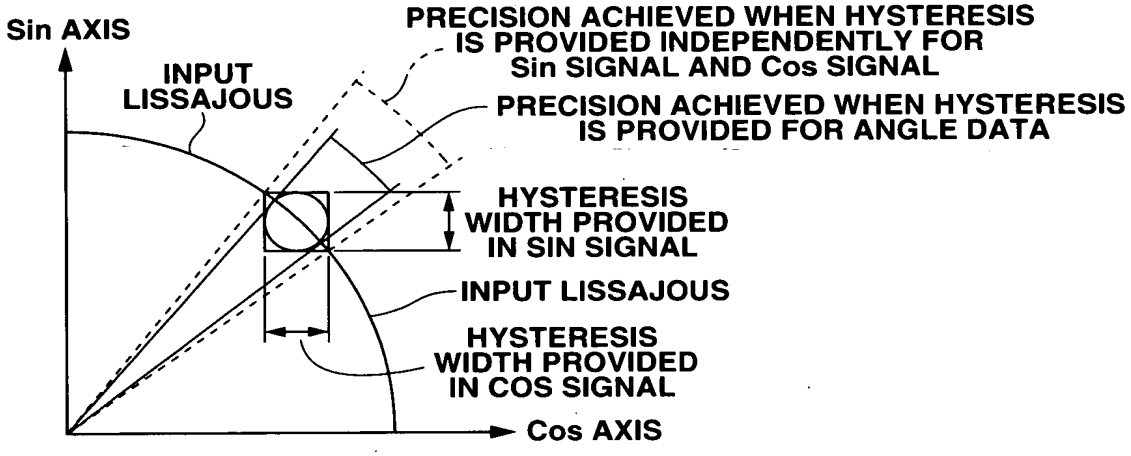

Sin AXIS
INPUT LISSAJOUS
PRECISION ACHIEVED WHEN HYSTERESIS IS PROVIDED INDEPENDENTLY FOR Sin SIGNAL AND Cos SIGNAL
PRECISION ACHIEVED WHEN HYSTERESIS IS PROVIDED FOR ANGLE DATA
HYSTERESIS WIDTH PROVIDED IN SIN SIGNAL
INPUT LISSAJOUS
HYSTERESIS WIDTH PROVIDED IN COS SIGNAL
Cos AXIS

FIG.27

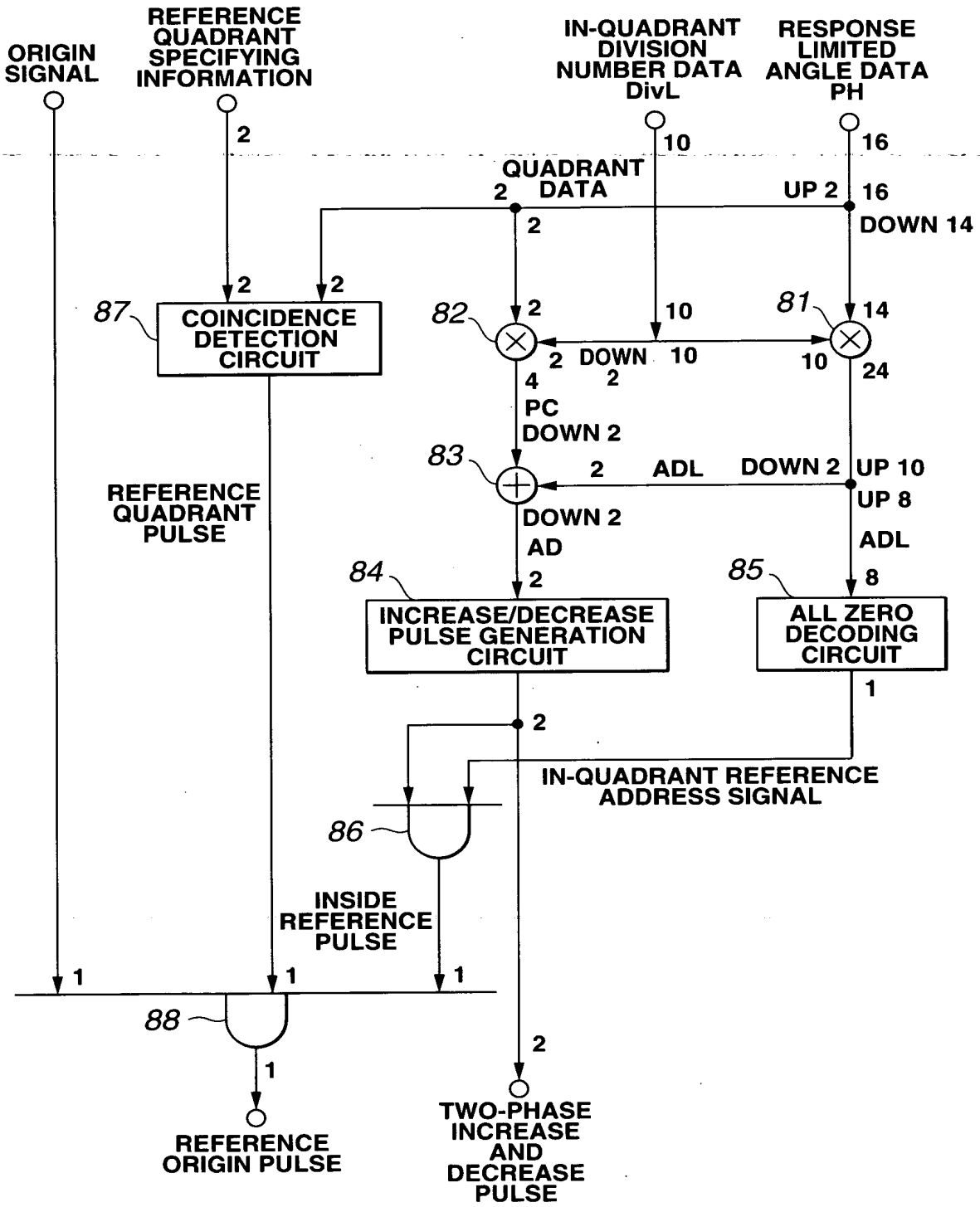

ORIGIN SIGNAL
REFERENCE QUADRANT SPECIFYING INFORMATION
IN-QUADRANT DIVISION NUMBER DATA DivL
RESPONSE LIMITED ANGLE DATA PH
QUADRANT DATA
UP 2
DOWN 14
87
COINCIDENCE DETECTION CIRCUIT
82
81
PC
DOWN 2
83
ADL
DOWN 2
UP 10
UP 8
ADL
DOWN 2
REFERENCE QUADRANT PULSE
84
INCREASE/DECREASE PULSE GENERATION CIRCUIT
85
ALL ZERO DECODING CIRCUIT
IN-QUADRANT REFERENCE ADDRESS SIGNAL
86
INSIDE REFERENCE PULSE
88
REFERENCE ORIGIN PULSE
TWO-PHASE INCREASE AND DECREASE PULSE

FIG.28

FIG.29A IN-QUADRANT ADDRESS ADL

FIG.29B ADDRESS IN ONE WAVELENGTH AD

FIG.29C SECOND BIT AD1 FROM THE BOTTOM IN ADDRESS IN ONE WAVELENGTH SAME

LEAST SIGNIFICANT BIT AD0

FIG.29D TWO-PHASE INCREASE AND DECREASE PULSE

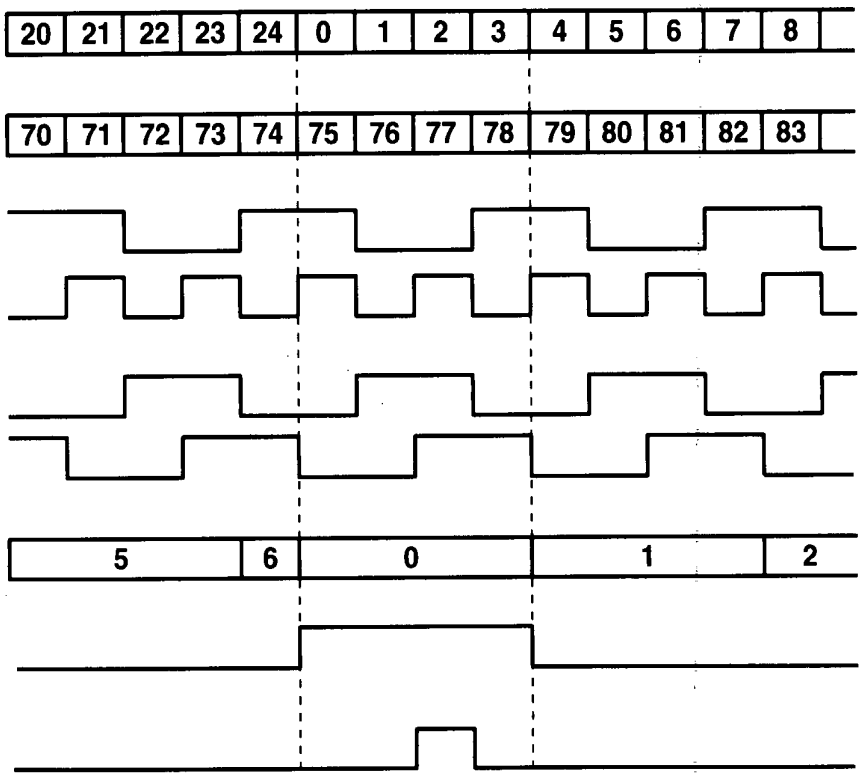
A PHASE SIGNAL

B PHASE SIGNAL

FIG.29E IN-QUADRANT ADDRESS ADL EXCLUDING LOWER 2 BITS

FIG.29F IN-QUADRANT REFERENCE ADDRESS SIGNAL

FIG.29G INSIDE REFERENCE PULSE



IN-QUADRANT DIVISION DivL	
SECOND MULTIPLIER INPUT	FIRST MULTIPLIER INPUT
(DivL9)	DivL9
(DivL8)	DivL8
(DivL7)	DivL7
(DivL6)	DivL6
(DivL5)	DivL5
(DivL4)	DivL4
(DivL3)	DivL3
(DivL2)	DivL2
DivL1	DivL1
DivL0	DivL0

FIG.30A

SECOND MULTIPLIER INPUT	FIRST MULTIPLIER INPUT	RESPONSE LIMITED ANGLE DATA PH	
			← DECIMAL POINT POSITION PER UNIT OF WAVELENGTH
PH15		PH15	
PH14		PH14	← DECIMAL POINT POSITION PER UNIT OF QUADRANT
	PH13	PH13	
	PH12	PH12	
	PH11	PH11	
	PH10	PH10	
	PH9	PH9	
	PH8	PH8	
	PH7	PH7	
	PH6	PH6	
	PH5	PH5	
	PH4	PH4	
	PH3	PH3	
	PH2	PH2	
	PH1	PH1	
	PH0	PH0	

FIG.30B

ONE WAVELENGTH DIVISION UNIT ADDRESS PD (ADDRESS IN ONE WAVELENGTH AD)=
CORRECTED ADDRESS PC +
IN-QUADRANT DIVISION UNIT ADDRESS PDL (IN-QUADRANT ADDRESS ADL)

OUTPUT OF CORRECTION ADDER	OUTPUT OF SECOND MULTIPLIER	OUTPUT OF SECOND MULTIPLIER	
(PD25)=(AD11)	(PC25)=(AC11)		
(PD24)=(AD10)	(PC24)=(AC10)		
(PD23)=(AD9)	(PC23)=(AC9)	PDL23=ADL9	
(PD22)=(AD8)	(PC22)=(AC8)	PDL22=ADL8	
(PD21)=(AD7)	(PC21)=(AC7)	PDL21=ADL7	
(PD20)=(AD6)	(PC20)=(AC6)	PDL20=ADL6	
(PD19)=(AD5)	(PC19)=(AC5)	PDL19=ADL5	
(PD18)=(AD4)	(PC18)=(AC4)	PDL18=ADL4	
(PD17)=(AD3)	(PC17)=(AC3)	PDL17=ADL3	
(PD16)=(AD2)	(PC16)=(AC2)	PDL16=ADL2	
PD15=AD1	PC15=AC1	PDL15=ADL1	FOR INCREASE/DECREASE PULSE GENERATION
PD14=AD0	PC14=AC0	PDL14=ADL0	
(PD13)		PDL13	
(PD12)		PDL12	
(PD11)		PDL11	DECIMAL POINT POSITION IN DIVISION ADDRESS
(PD10)		PDL10	
(PD9)		PDL9	
(PD8)		PDL8	
(PD7)		PDL7	
(PD6)		PDL6	
(PD5)		PDL5	
(PD4)		PDL4	
(PD3)		PDL3	
(PD2)		PDL2	
(PD1)		PDL1	
(PD0)		PDL0	

FIG.31